

WHAT IS CLAIMED IS:

1. A method for discharging fluid, comprising:
 - 5 while keeping two members relatively moving to each other along a gap direction of a gap formed by two opposing surfaces of the two members, feeding fluid from a fluid supply device to the gap; and
 - 10 intermittently discharging the fluid by utilizing a pressure change made by changing the gap, and controlling a fluid discharge amount per dot depending on pressure and flow rate characteristics of the fluid supply device.
- 15 2. The method for discharging fluid according to Claim 1, wherein the pressure and flow rate characteristics of the fluid supply device are set by changing a number of rotations of the fluid supply device.
- 20 3. The method for discharging fluid according to Claim 1, wherein assuming that a minimum value or a mean value of the gap is h_0 , the intermittent discharge is performed with the gap h_0 set to a range of $h_0 > h_x$, where a setting range of the gap h_0 over which an intermittent discharge amount per dot is generally proportional to the gap h_0 is $0 < h_0 < h_x$, and where a setting range of the gap h_0 over which the intermittent discharge amount is generally constant independent of the gap h_0 is $h_0 > h_x$, and where h_x is an intersection point between an envelope of the 25 intermittent discharge amount per dot relative to h_0 in a

region $0 < h_0 < h_x$, and a value of a portion of the region $h_0 > h_x$ over which the intermittent discharge amount per dot is generally constant independent of h_0 .

4. The method for discharging fluid according to
5 Claim 1, wherein assuming that a fluid pressure generated in inverse proportion to a size of the gap between the opposing surfaces of the two members and in proportion to time differential of the gap is a primary squeeze pressure, and that a fluid pressure generated in proportion to the time differential of the gap and in proportion to an internal resistance of the fluid supply device is a secondary squeeze pressure, and further that a minimum value or a mean value of the gap is h_0 ,

10 the intermittent discharge is performed by action of the secondary squeeze pressure with the gap h_0 set to a range of $h_0 > h_x$, a setting range of the gap h_0 over which an intermittent discharge amount per dot is generally proportional to the gap h_0 is $0 < h_0 < h_x$, and where a setting range of the gap h_0 over which an intermittent discharge amount is generally constant independent of the gap h_0 is $h_0 > h_x$, and where h_x is an intersection point between an envelope of the intermittent discharge amount per dot relative to h_0 in a region $0 < h_0 < h_x$, and a value of a portion of the region $h_0 > h_x$ over which the intermittent discharge amount per dot is generally constant independent of h_0 .

5. The method for discharging fluid according to
Claim 1, wherein assuming that a fluid pressure generated
in inverse proportion to a size of the gap between the
opposing surfaces of the two members and in proportion to
5 time differential of the gap is a primary squeeze pressure,
and that a fluid pressure generated in proportion to the
time differential of the gap and in proportion to an
internal resistance of the fluid supply device is a
secondary squeeze pressure, and further that a minimum
10 value or a mean value of the gap is h_0 , the intermittent
discharge is performed with the gap h_0 set to a value of
 $h_0 \approx h_x$ or to a range of $0 < h_0 < h_x$, where a setting range of the
gap h_0 over which an intermittent discharge amount per dot
is generally proportional to the gap h_0 is $0 < h_0 < h_x$, and
15 where a setting range of the gap h_0 over which the
intermittent discharge amount is generally constant
independent of the gap h_0 is $h_0 > h_x$, and where h_x is an
intersection point between an envelope of the intermittent
discharge amount per dot relative to h_0 in a region $0 < h_0 < h_x$,
20 and a value of a portion of the region $h_0 > h_x$ over which the
intermittent discharge amount per dot is generally constant
independent of h_0 .

6. The method for discharging fluid according to
Claim 3, wherein h_x is a value of an intersection point
25 between an envelope of a curve relative to h_0 in a region

$0 < h_0 < h_x$, and a portion of the region $h_0 > h_x$ over which the curve is generally constant independent of h_0 .

7. The method for discharging fluid according to Claim 3, wherein assuming that a fluid internal resistance of the fluid supply device is R_s (kgsec/mm⁵), a radial fluid internal resistance of the opposing surfaces of the relatively moving two members that depends on the gap h_0 of the opposing surfaces of the two members is R_p (kgsec/mm⁵), a fluid resistance of the discharge port is R_n (kgsec/mm⁵), and if a function ϕ is defined as

$$\phi = \frac{1}{R_s + R_p + R_n}$$

then h_x is a value of an intersection point between an envelope of a curve ϕ relative to h in a region $0 < h < h_x$, and a portion of the region $h_0 > h_x$ over which the curve ϕ is independent of h_0 and generally constant.

8. The method for discharging fluid according to Claim 1, wherein if a maximum value of time differential of the gap is V_{max} , a mean radius of outer peripheries of the two members is r_0 (mm), a mean radius of a discharge opening for connecting the gap and outside of the device is r_i (mm), and if a maximum flow rate of the fluid supply device is Q_{max} , then

$$Q_{max} < \pi(r_0^2 - r_i^2)V_{max}.$$

9. The method for discharging fluid according to

Claim 1, wherein the two members that are relatively moved to each other along a gap direction by independent axial direction drive devices are provided in a plurality of sets, and the fluid is supplied by one set of fluid supply device in branches to gaps between these sets of two members.

5 10. The method for discharging fluid according to Claim 9, wherein each discharge amount is controlled by setting the gap between opposing surfaces of respective two members to a proximity to $h_0 \approx h_x$ or to a range of $0 < h_0 < h_x$.

10 11. The method for discharging fluid according to Claim 1, wherein an equal discharge amount per dot of fluid is intermittently discharged for coating periodically at equal time intervals while discharge nozzles and a substrate are kept relatively running to each other by making use of a property that a coating-object surface of 15 the substrate is geometrically symmetrical.

12. The method for discharging fluid according to Claim 11, wherein the coating-object surface is a surface of a display panel.

20 13. The method for discharging fluid according to Claim 1, wherein fluid is supplied to opposing surfaces of two members that are relatively moved to each other along a gap direction by a fluid supply device, and wherein given a gap h (mm) of the two opposing surfaces, time differential dh/dt of the gap h , a mean radius r_0 (mm) of outer

peripheries of the two opposing surfaces, a mean radius r_i (mm) of a discharge opening for connecting the gap and outside, a viscosity coefficient μ (kgsec/mm²) of the fluid, a fluid internal resistance R_s (kgsec/mm⁵) of the fluid supply device, a radial fluid resistance R_p (kgsec/mm⁵) of the two opposing surfaces, a fluid resistance R_n (kgsec/mm⁵) of the discharge opening, a sum P_{s0} of a maximum pressure and a supply pressure of the fluid supply device, and given a frequency f (1/sec) of intermittent discharge, it holds that $P_{s0} + P_{squ10} + P_{squ20} < 0$, where a primary squeeze pressure P_{squ1} and a secondary squeeze pressure P_{squ2} are defined as

$$P_{squ1} = -\frac{3\mu}{h^3} \frac{dh}{dt} \left\{ (r_0^2 - r_i^2) + 2r_i^2 \ln \frac{r_i}{r_0} \right\}$$

$$P_{squ2} = -R_s \pi \frac{dh}{dt} (r_0^2 - r_i^2)$$

and where a primary squeeze pressure P_{squ1} and a secondary squeeze pressure P_{squ2} resulting when the time differential dh/dt of the gap h has a maximum value are $P_{squ1} = P_{squ10}$ and $P_{squ2} = P_{squ20}$, respectively.

14. The method for discharging fluid according to Claim 1, wherein in an application process in which coating is performed as the discharge while a coating-object surface and a discharge nozzle for connecting to the gaps are being relatively moved to each other, given a displacement input signal Sh that gives the gap between the

two opposing surfaces, relative positions of the coating-object surface and the discharge nozzle and a timing of the displacement input signal Sh are adjusted by taking into consideration that a phase of coating is advanced by 5 generally $\Delta\theta=\pi/2$ over the displacement input signal Sh .

15. The method for discharging fluid according to Claim 1, wherein the two members are relatively moved by an electro-magnetostriiction element.

10 16. The method for discharging fluid according to Claim 1, wherein an amplitude immediately before a halt of coating of the two members that are relatively moved to each other along the gap direction is larger than an amplitude of steady intermittent application.

15 17. The method for discharging fluid according to Claim 1, wherein while a dispenser for discharging the fluid through the gap is being relatively moved to a substrate on which independent ribs each surrounded by a barrier rib are formed geometrically symmetrical, fluorescent-material paste is intermittently discharged so 20 that the fluorescent-material paste is applied to interiors of the independent cells one by one, by which a fluorescent-material layer of a plasma display panel is formed.

25 18. The method for discharging fluid according to Claim 17, wherein the fluorescent-material paste is flown

from the discharge nozzle so as to be applied while a distance H between a crest of the barrier rib and a tip end portion of the discharge nozzle is maintained at 0.5 mm or more.

5 19. The method for discharging fluid according to Claim 18, wherein the distance H is 1.0 mm or more.

20. The method for discharging fluid according to Claim 1, wherein the two opposing surfaces of the two members that are relatively moved to each other along a gap direction by independent axial direction drive devices are provided in a plurality of sets, and the fluid is supplied by one set of fluid supply device in branches to gaps between these sets of two members, and wherein each discharge amount is controlled by a flow-rate compensation device which is provided on a flow passage that connects the fluid supply device and the two opposing surfaces of the relatively moving two members to each other and which is capable of changing a flow passage resistance.

15 21. The method for discharging fluid according to Claim 1, further comprising: in a coating process of intermittent application performed while the gap between the opposing surfaces of the relatively moving two members is varied at an amplitude h_1 , increasing the gap between the opposing surfaces of the two members at an amplitude h_2 larger than the amplitude h_1 to interrupt the discharge;

and thereafter performing intermittent application a plurality of times at the amplitude h_1 so that a central value of the gap after the interruption becomes gradually equal to a central value of the gap immediately before the
5 interruption.

22. The method for discharging fluid according to Claim 1, wherein assuming that a time at an end of an (n-1)th application from a start of an application is T_{n-1} , a time at a start of an n-th application is T_n , and a time interval is $\Delta T = T_n - T_{n-1}$, then an n-th application quantity 10 per dot is controlled by setting a value of the ΔT .

23. A device for discharging fluid, comprising:
15 two members for relatively moving to each other along a gap direction with a discharge chamber formed by these two members; and

20 a fluid supply device for supplying fluid to the discharge chamber with a suction port provided on an upstream side of the fluid supply device and a discharge port that communicates the discharge chamber and outside with each other,

25 wherein the fluid is intermittently discharged from the discharge port by utilizing a pressure change due to a change of the gap formed by the two members, while a discharge amount per dot of the fluid is controlled by setting of pressure and flow-rate characteristics of the

fluid supply device.

24. The device for discharging fluid according to
Claim 23, wherein assuming that a fluid pressure generated
in inverse proportion to a size of the gap between opposing
5 surfaces of the relatively moving two members and in
proportion to time differential of the gap is a primary
squeeze pressure, and that a fluid pressure generated in
proportion to the time differential of the gap and in
proportion to an internal resistance of the fluid supply
10 device is a secondary squeeze pressure, and further that a
minimum value or a mean value of the gap is h_0 ,

the intermittent discharge is performed by action
of the secondary squeeze pressure with the gap h_0 set to a
range of $h_0 > h_x$, where a setting range of the gap h_0 over
15 which an intermittent discharge amount per dot is generally
proportional to the gap h_0 is $0 < h_0 < h_x$, and where a setting
range of the gap h_0 over which an intermittent discharge
amount is generally constant independent of the gap h_0 is
 $h_0 > h_x$, and where h_x is an intersection point between an
envelope of the intermittent discharge amount per dot
20 relative to h_0 in a region $0 < h_0 < h_x$, and a value of a portion
of the region $h_0 > h_x$ over which the intermittent discharge
amount per dot is generally constant independent of h_0 .

25. The device for discharging fluid according to
Claim 23, wherein assuming that a fluid pressure generated

in inverse proportion to a size of the gap between opposing surfaces of the relatively moving two members and in proportion to time differential of the gap is a primary squeeze pressure, and that a fluid pressure generated in proportion to the time differential of the gap and in proportion to an internal resistance of the fluid supply device is a secondary squeeze pressure, the discharge amount is controlled with the gap h_0 set to a value of $h_0 \approx h_x$ or to a range of $0 < h_0 < h_x$, where a setting range of a minimum value or a mean value h_0 of the gap is $0 < h_0 < h_x$, and where a setting range of the gap h_0 over which the intermittent discharge amount is generally constant independent of the gap h_0 is $h_0 > h_x$, and where h_x is an intersection point between an envelope of the intermittent discharge amount per dot relative to h_0 in a region $0 < h_0 < h_x$, and a value of a portion of the region $h_0 > h_x$ over which the intermittent discharge amount per dot is generally constant independent of h_0 .

26. The device for discharging fluid according to
20 Claim 23, wherein the two members for relatively moving to each other along a gap direction by an independent axial direction drive device are provided in a plurality of sets, and the fluid is supplied by one set of fluid supply device in branches to gaps between opposing surfaces of these sets
25 of two members.

27. The device for discharging fluid according to
Claim 25, wherein the two members for relatively moving to
each other along a gap direction by an independent axial
direction drive device are provided in a plurality of sets,
5 and the fluid is supplied by one set of fluid supply device
in branches to gaps between opposing surfaces of these sets
of two members, and wherein each discharge amount is
controlled by setting a minimum value or a mean value of
the gap between each two members to a proximity to $h_0 \approx h_x$ or
10 to a range of $0 < h_0 < h_x$, respectively.

28. The device for discharging fluid according to
Claim 23, wherein the fluid supply device is a pump which
can change a flow rate of the fluid by its number of
rotations.

15 29. The device for discharging fluid according to
Claim 28, wherein the fluid supply device is a thread
groove pump.

30. The device for discharging fluid according to
Claim 23, wherein assuming that a minimum value or a mean
20 value of the gap between opposing surfaces of the
relatively moving two members is h_0 , then $h_0 > 0.05$ mm.

31. A device for discharging fluid, comprising:
25 a sleeve for housing a shaft;
a housing for housing the shaft and the sleeve;
a device for rotating the sleeve relative to the

housing;

an axial direction drive device for giving the shaft an axial-direction relative displacement relative to housing, a discharge chamber being defined by a discharge-
5 side end face of the shaft and the housing;

a fluid supply device for supplying a fluid to the discharge chamber by utilizing relative rotation of the sleeve and the housing, a suction port and a discharge port of the fluid communicating the discharge chamber and
10 outside with each other; and

a device for pressure-feeding the fluid, which has flowed into the discharge chamber, toward the discharge port side with the axial direction drive device,

wherein a continuous flow of the fluid fed from
15 the fluid supply device is converted into an intermittent flow by utilizing a pressure change due to a change of a gap of the discharge chamber, and moreover an intermittent discharge amount per dot of the fluid is controlled by setting of number of rotations.

20 32. The device for discharging fluid according to Claim 31, wherein the shaft and the sleeve are structurally integrated together.

33. A device for discharging fluid, comprising:

an axial direction drive device for giving an
25 axial-direction relative displacement to between a shaft

and a housing, a discharge chamber being defined by a shaft end face of the shaft and the housing; and

5 a fluid supply device for supplying a fluid to the discharge chamber, a flow passage communicating the discharge chamber and the fluid supply device with each other, a suction port being formed in the fluid supply device, and a discharge port communicating the discharge chamber and outside with each other,

10 wherein a continuous flow of the fluid fed from the fluid supply device is converted into an intermittent flow by utilizing a pressure change due to a change of a gap of the discharge chamber, and moreover an intermittent discharge amount per dot of the fluid is controlled by setting of number of rotations or a gap of an interval 15 leading from the flow passage to the discharge port.

34. The device for discharging fluid according to Claim 33, wherein the fluid is supplied to a plurality of sets of the discharge chambers via flow passages branched from one set of the fluid supply device.

20 35. The device for discharging fluid according to Claim 33, wherein the flow passage is an easy-to-deform flexible pipe.

36. The device for discharging fluid according to Claim 23, wherein the device for relatively moving the two 25 members is an electro-magnetostriiction element.

37. A method for discharging fluid, comprising: while keeping two members for relatively moving to each other along a gap direction, feeding fluid from a fluid supply device to the gap; and controlling interruption and release 5 of fluid discharge by utilizing a pressure change made by changing the gap, and assuming that a minimum value or a mean value of the gap is h_0 , performing the fluid discharge with the gap h_0 is set to a range of h_0, h_x , where a setting range of the gap h_0 over which a steady-state discharge 10 amount Q of the fluid is generally proportional to the gap h_0 is $0 < h_0 < h_x$, and where a setting range of the gap h_0 over which the discharge amount is generally constant independent of the gap h_0 is $h_0 > h_x$.